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ACUTE ISCHEMIC STROKE RISK FACTORS STRATIFICATION MODEL IN ISOLATED VERTIGO PATIENTS: TWO-YEARS COHORT RETROSPECTIVE STUDY

Faizal Muhammad*, Rivan Danuaji

***Correspondence:** faizal9m@student.uns.ac.id*
Department of Neurology, Faculty of Medicine, Universitas Sebelas Maret, Surakarta, Indonesia

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ABSTRACT

Background: Vertigo is a common complaint in medical settings, with the most important differential diagnosis to exclude being vertebrobasilar ischemic stroke. However, there have been no cohort studies evaluating the risk of stroke following hospitalization for acute vertigo without other neurological symptoms (isolated vertigo).
Objective: To assess the long-term risk of stroke in patients with a history of hospitalization due to isolated vertigo.
Methods: This retrospective cohort study was conducted at Dr. Moewardi Hospital in Surakarta, utilizing secondary data from electronic medical records for the years 2024–2025. A total of 268 patients hospitalized for vertigo and 223 control patients (elective gastrointestinal endoscopy patients) were selected based on similar age distribution. Stroke incidence data were analyzed using Kaplan-Meier methods and Cox regression, with adjustments for demographic variables and vascular risk factors.
Results: Over a 2-year period, stroke occurred in 16 vertigo patients (5.8%) and 2 control patients (1.1%). After adjustment, vertigo patients had a 3.25-fold higher risk of stroke compared to the control group (HR: 3.25; 95% CI: 2.18–4.15; p = 0.002). Stroke risk significantly increased in patients with ≥3 vascular risk factors (HR: 5.01). Approximately 68% of strokes occurred within the first year.
Conclusion: Isolated vertigo significantly increases the risk of ischemic stroke, particularly in patients with risk factors during the first year following the initial symptoms of isolated vertigo.

Keywords: cerebrovascular disease, comorbidity, risk factor, stroke, vertigo

Introduction

Vertigo, defined as the sensation of spinning, is a common symptom encountered in medical services, particularly in otolaryngology, neurology, and primary care.[1,2] Although it often originates from peripheral vestibular disorders (such as benign paroxysmal positional vertigo), vertigo can also be an early sign of a stroke, especially involving the vertebrobasilar system (the blood circulation to the brainstem and cerebellum).[3,4] Population-based studies have shown that 3.2–5% of patients presenting with vertigo or dizziness are diagnosed with stroke.[5] Vertigo, in isolation, is rarely indicative of vertebrobasilar insufficiency.[6,7]

Recent reports have highlighted that isolated vertigo may be the primary or only symptom observed in patients with stroke.[8] However, many cases of vertigo without other neurological signs are considered benign.[9] Thus, we investigate if patients admitted to the hospital with acute vertigo (in the absence of other symptoms) face an increased long-term risk of stroke.

Methods

This retrospective cohort study was performed for two years (2024-2025) based on hospital electronic medical record. The study included 268 patients who were hospitalized for isolated vertigo, classified under ICD-10 H81.1-H81.9, excluding H81.3 for vertigo of

central origin. A control group of 223 patients who underwent elective gastrointestinal (GI) endoscopy were selected, as this group represents the general population and is not associated with an increased risk of stroke. Any prior history of stroke subtypes were excluded from both groups to ensure that any latest subsequent strokes were related to the study's baseline conditions.

Data on stroke occurrence were collected during a 2-year follow-up period after hospital discharge. The Cox proportional hazards model was employed to calculate the hazard ratio (HR) for stroke risk. Adjustments were made for potential confounding variables, including age, sex, hypertension, diabetes, coronary artery disease, hyperlipidemia, socioeconomic status, education degree, and urbanization level (Table 1). This analysis aimed to determine the relative stroke risk for patients with isolated vertigo compared to the general population while controlling for these factors.[10]

Results

The risk of stroke was significantly higher in patients with vertigo compared to the control group . Over a 2-year period, 16 vertigo patients (5.8%) experienced a stroke, compared to 2 control patients (1.1%). After adjusting for confounding factors, the hazard ratio (HR) for stroke in vertigo patients was found to be 3.25 (95% CI: 2.18–4.15; p = 0.002), indicating that vertigo patients were three times more likely to experience a ischemic stroke over the 2-year period compared to the general population (Table 2).

Furthermore, the incidence of stroke was highest within the first one-year after hospitalization for vertigo, with 68% of strokes occurring during this period. The median time to stroke occurrence was 8.64 months. That six key factors were associated with an increased risk of stroke. Risk factor analysis identified six key factors associated with an increased risk of stroke: age >50 years, male gender, diabetes, hypertension, hyperlipidemia, and coronary artery disease. Vertigo patients were categorized into three risk groups based on the number of these factors. The 2-year stroke incidence was 1.7% (1.0–2.9) for those with no risk factors (HR: 1, as reference), 5.5% (3.3–7.9) for those with 1–2 risk factors (HR: 3.00, 1.72–5.16), and 12% (9.2–16.1) for those with 3 or more risk factors (HR: 5.01, 3.02–9.65) (Table 3 and Figure 1).

Discussion

Patients with isolated vertigo are at a significantly higher risk of stroke compared to the general population.[6] Over a two-year follow-up period, the incidence of stroke in vertigo patients (5.8%) was substantially higher than in the control group (1.1%). This finding aligns with previous studies suggesting that vertigo, especially when presenting without other neurological symptoms, should not be dismissed as a benign condition.[11] Isolated vertigo, particularly in older adults, can serve as an early indicator of potential cerebrovascular events.[12] Moreover, vertigo can indeed be an early manifestation of vertebrobasilar ischemia affecting brainstem and cerebellum.[13]

Moreover, the study found that stroke risk escalates dramatically in patients with multiple vascular risk factors.[14,15] Specifically, vertigo patients with three or more risk factors had a 5.01-fold higher risk of stroke compared to those with no risk factors.[16] This result is consistent with established literature showing that individuals with risk factors like hypertension, diabetes, and hyperlipidemia are at a heightened risk for ischemic stroke.[17] These findings emphasizing the importance of managing these factors early to prevent posterior-circulation cerebrovascular events.[18] Majority of strokes occurring within the first year following hospitalization for vertigo.

This retrospective design limits causal inference, and reliance on secondary data may lead to incomplete information, particularly regarding lifestyle factors like smoking-status or physical activity.[19,20] Future studies should focus on prospective designs with extended follow-up periods, multi-centre participation, larger sample sizes, more adjusted-lifestyle factors, to assess the long-term stroke risk in patients with isolated vertigo, providing a clearer understanding of its sustained impact.

Table 1. Demographic features and comorbid conditions of the vertigo and control groups

Variable	Vertigo Group (n=268) N (%)	Control Group (n=223) N (%)	P*
Gender			
Male	94 (35%)	105 (47%)	0.100
Female	174 (65%)	118 (53%)	
Age (years)			
<40	71 (26%)	59 (26%)	0.853
40–59	119 (44%)	97 (44%)	
60–79	58 (22%)	56 (25%)	
≥80	20 (8%)	11 (5%)	
Diabetes			
Yes	68 (25%)	73 (33%)	0.068
No	200 (75%)	150 (67%)	
Hypertension			
Yes	39 (15%)	47 (21%)	0.137
No	229 (85%)	176 (79%)	
Hyperlipidemia			
Yes	23 (9%)	18 (8%)	0.673
No	245 (91%)	205 (92%)	

Variable	Vertigo Group (n=268) N (%)	Control Group (n=223) N (%)	P*
Coronary Artery Disease			
Yes	28 (10%)	18 (8%)	0.450
No	240 (90%)	205 (92%)	
Academic Degree			
Illiterate	59 (22%)	60 (27%)	0.980
Primary	115 (43%)	99 (44%)	
High School	78 (29%)	51 (23%)	
University	16 (6%)	13 (6%)	
Urbanization			
Urban	45 (17%)	44 (20%)	0.634
Suburban	115 (43%)	91 (41%)	
Rural	108 (40%)	88 (39%)	

*Chi-square test for all categorical variables. Significant difference if P < 0.05

Table 2. Unadjusted and adjusted (based on: age, sex, comorbidities) hazard ratios for stroke over a 2-year follow-up

Group	Stroke (%)	Unadjusted HR (95% CI)	P*	Adjusted HR (95% CI)	P*
Vertigo (n=268)	16 (5.8)	3.53 (2.39–4.47)	<0.001	3.25 (2.18–4.15)	0.002
Control (n=223)	2 (1.1)	1		1	

*Cox proportional hazards model. P-value < 0.05 showed the difference in hazard ratios between the groups is statistically significant

Table 3. Cumulative risk and adjusted hazard ratios based on risk factor stratification in vertigo patient group (n=268)

N of Risk Factors[a]	Stroke Events, N (%)	1-Year Stroke Risk, % (95% CI)	2-Year Stroke Risk, % (95% CI)	Adjusted HR (95% CI)	P*
≥3 (n=23)	10 (43.47)	4.2 (2.1–7.1)	12.0 (9.2–16.1)	5.01 (3.02–9.65)	<0.001
1–2 (n=112)	5 (4.46)	2.0 (1.2–3.3)	5.5 (3.3–7.9)	3.00 (1.72–5.16)	<0.001
0 (n=133)	1 (1.23)	0.8 (0.2–2.0)	1.7 (1.0–2.9)	1	

[a]Risk factors such as age >50 years, male gender, diabetes, hypertension, hyperlipidemia, and coronary artery disease. *Cox proportional hazards regression model. P < 0.05 showed difference in the adjusted hazard ratios between the different risk categories (≥3, 1-2, and 0 risk factors) is statistically significant

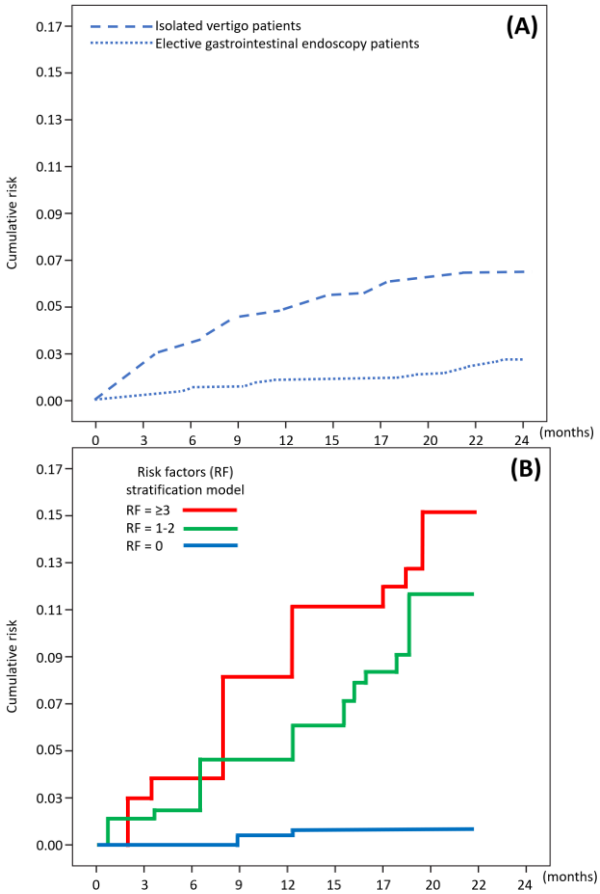

Figure 1. (A) Stroke cumulative risk in both isolated vertigo and elective gastrointestinal endoscopy patients for 2-year retrospective follow-up; (B) Risk factor stratification model for stroke and its cumulative risk since hospitalization discharge of isolated vertigo patient

Conclusion

Isolated vertigo significantly increases the risk of ischemic stroke, with 5.8% of vertigo patients experiencing stroke over a two-year period, compared with 1.1% of patients in the control group (HR: 3.25; 95% CI: 2.18–4.15; p=0.002). Stroke risk is notably higher in patients with 3 or more risk factors (12% at 2 years, HR: 5.01; 95% CI: 3.02–9.65), with 68% of strokes occurring within the first year. These findings highlight the importance of early risk stratification and vascular risk factor management, particularly during the first year after hospitalization.

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Declaration of Interests

The authors declare that there are no conflicts of interest related to this study. No relevant financial relationships or affiliations to disclose.

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